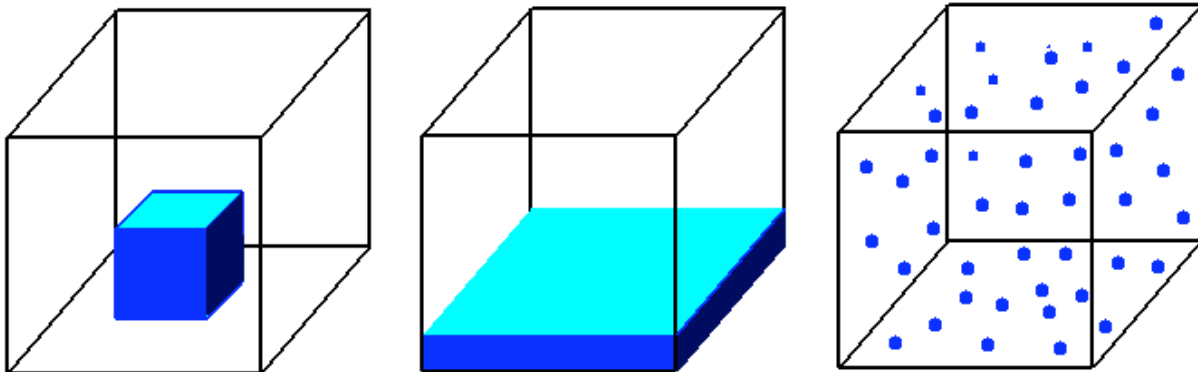




States of Matter: Solids, Liquids, Gases & Beyond

A Digital Learning Network Program
5-12



Digital Learning Network (DLN)

A DLN interactive videoconferencing event is a one time connection that allows students to experience NASA first-hand. Each event features an integrated educational package of grade-appropriate instruction and activities centered around a 50-minute videoconference. Students participate in a Question and Answer session with a NASA Education Specialist or a NASA Subject Matter Expert.

SEQUENCE OF EVENTS

Pre-Conference Requirements

Printable and Online Pre-assessment: A pre-assessment tool is available to determine the students' level of understanding prior to the videoconference.

Videoconference

(45-minute videoconference) "States of Matter: Solids, Liquids, Gases, & Beyond" engages students in a discussion of the states of matter, properties of matter, and the extreme cases NASA encounters. This DLN Module includes exciting vacuum chamber and liquid Nitrogen demonstrations. The module is designed to encourage students' questions and Inquiry-based learning.

Post-Conference Requirements

Printable and Online Post-assessment

A post-assessment tool is available to determine changes in student levels of understanding. Answers are included.

INSTRUCTIONAL OBJECTIVES

Engage: Students will compare and contrast the states of matter.

Explore: Students will explore properties of matter.

Explain: Students will explain phase changes.

Elaboration: Students will encounter the extreme cases of states of matter.

Evaluation: Students will synthesize their own questions regarding states of matter.

NATIONAL STANDARDS

National Science Content Standards:

Physical Science 5-8

- Properties and Changes of Properties in Matter
- Transfer of Energy

Physical Science 9-12

- Structure and Properties of Matter
- Conservation of Energy and the Increase in Disorder

PRE-CONFERENCE REQUIREMENTS

Pre-Videoconference Activity:

Students can take a pre-assessment quiz online or teachers are welcome to print and make copies. This quiz reveals students' preconceptions about the key concepts and sets the stage for the videoconference.

Link to Pre-assessment quiz:

<http://dln.nasa.gov/dln/content/quiz/?quuid=1221775792746&prepost=pre>

Pre-Videoconference Procedures:

1. Clear an area in the room large enough for twelve students to stand close together. This area should also be large enough for the students to be able to move around each other and switch places.
2. Have all students place their backpacks and other items underneath their chairs.
3. Clean up any items on the floor of the entire classroom that may represent a tripping hazard.

During the Videoconference:

Assist students as they take their positions for the activity.

During the Videoconference: Activity Summary

Students will be divided into three groups by the classroom teacher to play the role of molecules in this activity designed to demonstrate the molecular motion of the states of matter.

In solids the forces of attraction between molecules or particles is stronger than the kinetic energy so particles are held in place and just vibrate. To demonstrate this the students in the solids group will stand in place and shake.

As temperature goes up they vibrate more and more until they are no longer held in place and become liquid. There is still enough attraction to keep them close together so a constant volume is maintained. To demonstrate this students in the liquids group will be allowed to move around but stay within six inches of each other.

As temperature continues to increase and the energy level goes up the molecules move faster and faster until they overcome essentially all attraction between them and become gas particles. To demonstrate this students in the gases group will be allowed to wander all around the room-don't worry, we'll explain if your principal walks in.

Vocabulary

Condensation: The change of the physical state of matter from gas to liquid. The opposite of evaporation.

Deposition: The change of the physical state of matter from gas directly to solid. The opposite of sublimation.

Evaporation: The change of the physical state of matter from a liquid to a gas. The opposite of condensation.

Freezing: The change of the physical state of matter from liquid to solid. The opposite of melting.

Gas: The state of matter without a set shape or volume.

Liquid: The state of matter with a set volume but no set shape.

Matter: Anything that both occupies space and has mass.

Mass: The amount of matter contained in an object.

Melting: The change of the physical state of matter from solid to liquid. The opposite of freezing.

Phase Change: The transition of matter from one state to another.

Plasma: Highly ionized (charged) gases that exist at high temperatures.

Pressure: The amount of force per unit area.

Solid: The state of matter with a set volume and a set shape.

Sublimation: The change of the physical state of matter from solid directly to gas. The opposite of deposition.

Temperature: Measure of increasing kinetic energy from solid to liquid to gas.

Volume: The amount of space an object occupies.

Name _____ Circle One: Pre Post Date _____

Pre and Post Assessment Directions:

For numbers 1-11, Circle True or False

1. True or False: Solids have a set shape.
2. True or False: Solids have a set volume.
3. True or False: Solids that are the same size must weigh the same.
4. True or False: Liquids do not have a set shape.
5. True or False: Liquids have a set volume.
6. True or False: All liquids freeze at the same temperature.
7. True or False: Liquids must be hot in order to boil.
8. True or False: Gases do not have a set volume.
9. True or False: Gases take the shape of their container.
10. True or False: Gases have no weight.
11. True or False: Air cannot be turned into a liquid.
12. Multiple Choice: A phase change from a solid to a liquid is called?
 - a. Condensation
 - b. Freezing
 - c. Melting
 - d. Boiling

Pre and Post Assessment answer key

1. True or False: Solids have a set shape.
True
2. True or False: Solids have a set volume.
True
3. True or False: Solids that are the same size must weigh the same.
False
4. True or False: Liquids do not have a set shape.
True
5. True or False: Liquids have a set volume.
True
6. True or False: All liquids freeze at the same temperature.
False: For example liquid Nitrogen does not freeze at 0° Celsius but water does.
7. True or False: Liquids must be hot in order to boil.
False: Water can boil at room temperature under a high vacuum.
8. True or False: Gases do not have a set volume.
True
9. True or False: Gases take the shape of their container.
True
10. True or False: Gases have no weight
False: In fact, some gases are heavier than others.
11. True or False: Air cannot be turned into a liquid.
False: Air consists of Nitrogen and Oxygen both of which liquefy below -183° Celsius
12. Multiple Choice: A phase change from a solid to a liquid is called?
c. Melting

Post-Conference Activity

Students can take a post-assessment quiz. This quiz revisits students' preconceptions about the key concepts and reveals how they have changed.

Link to Post-assessment quiz:

<http://dln.nasa.gov/dln/content/quiz/?quuid=1221775792746&prepost=post>

NASA Education Evaluation

We want to thank you for taking the time to participate in a NASA DLN event. The event couldn't have happened without your support and flexibility!

In order to assess our performance, we are asking that you, any fellow teachers, and all students who participated in today's event please go to our evaluation site at:

<http://dln.nasa.gov/dln/content/feedback/> and click on our center's survey name or cut and paste its url into your browser. By providing us with this feedback, you help to continue improving our programs and help them to remain free of cost to educators across the country, as we are held accountable for evaluating our offerings.

Contributors and Developers

Damon Talley	Kennedy Space Center
Roger Storm	Glenn Research Center

Special Thanks to the following organizations and people

James Fesmire
Principal Investigator, Cryogenics
Applied Technology Directorate
John F. Kennedy Space Center

Wesley L. Johnson
Cryogenics Engineer
Cryogenics Test Laboratory
John F. Kennedy Space Center